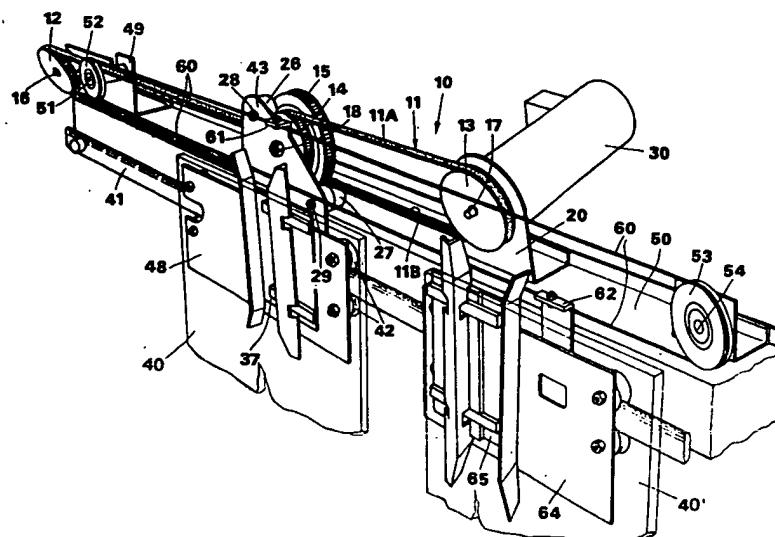




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(54) Title: LINEAR DOOR OPERATOR, WITH CLUTCH, FOR ELEVATORS



(57) Abstract

Linear operator (10) for elevator doors in which the door panels (40, 40') are drawn along by means of a continuous belt (11) supported by two end wheels (12, 13) one of which (13) is connected to the shaft of an electric motor (30) and, by means of a pair of coaxial wheels (14, 15) of different diameters fixed together by an intermediate clutch disk, turns idly on a pin (18) fixed to a supporting arm (43) integral with the door panel (40), one wheel (14) of said pair being in contact with the inner side of one section (11A) of the belt (11) and the other wheel (15) of the pair being in contact with the inner side of the other section (11B) of the belt (11), translating in a direction opposite to that of the other section.

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LINEAR DOOR OPERATOR, WITH CLUTCH, FOR ELEVATORS

The invention concerns an apparatus for working elevators. Movement of door panels in elevators is controlled by what are known as door operators, and is controlled by electric
5 motors through ratiomotors, these being required on account of the considerable difference between the high speed of the motor and the lower speed of the door panels which, for functional and safety purposes, must necessarily move more slowly.

10 Further if, during their closing stage the doors meet an obstacle, such as the body of a passenger, for safety reasons door movement must instantly be halted.

The electric motor must therefore stop, reverse its movement and return the doors to their fully open position. To
15 do this suitable sensors, special safety devices and automatic mechanisms are needed.

If the door is a two-panel door the pulleys, supported by the door panels themselves - enabling them to be drawn along by cables - increase the amount of material situated
20 above the doors. Because of this the present type of door operators are found to be bulky and complex as well as delicate,

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drawbacks of some importance bearing in mind the limited space allocated to elevator installations, reduced by the presence of stairways as well as the apartments in the building, and the need for elevators to carry the greatest
5 number of passengers possible rapidly and without hindrances to the service.

Purpose of the invention is considerably to reduce the bulk of equipment and automatic parts by making them simpler and also by simplifying erection and maintenance and by increas-
10 ing the safety factor of the elevator.

Subject of the invention is a linear lift door operator in which the door panels are pulled along by means of a continuous belt supported by two end wheels and by means of a pair of coaxial wheels of different diameter joined to-
15 gether, turning freely round a pin mounted on a supporting arm in turn fixed to the door panels.

The operative circumference of the larger wheel maintains contact with the inner side of one section of the belt between the two end wheels moving in one direction, while the
20 operative circumference of the smaller wheel maintains contact with the inner side of the second section of the belt moving in the opposite direction.

One of the end wheels that support said belt is connected to the shaft of an electric motor.

25 From the foregoing, door movement caused by motor rotation is made at a reduction ratio equal to the algebraic sum of the pull exerted by the two sections of the belt respectively on the operative circumference of the larger wheel and on that of the smaller wheel.

30 The pair of two coaxial wheels are held together by an intermediate coaxial clutch disk and are served by a mechanical

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device which, if the closing door encounters any kind of obstacle, causes reciprocal slippage of said wheels in one direction but not in the other.

Therefore, in the event of an obstacle being encountered
5 by the door during its closing movement, causing the pin common to the pair of coaxial wheels to slow down or stop, said wheels, drawn along by the two sections of the belt respectively, will continue to turn in the same direction but at different speeds thus provoking slippage.

10 Preferably said slippage is provoked by means of a mechanical device of the type known as free wheel, or equivalent, allowing relative slippage in the direction of door closure but not in the opposite direction.

Slippage is controlled by a device that stops it and re-
15 verses motor movement causing the doors to open.

The occupant can of course open the door by hand, if an emergency such as a power failure or some other should occur, and this will cause slippage of the aforesaid pair of wheels and overcome resistance offered by the
20 interposing clutch.

The wheels acting on the belt are preferably toothed wheels and the belt is similarly toothed.

Pins are also mounted on the arm fixed to the door to which the coaxial wheel pin is also fixed, said pins
25 being parallel to said pin in the coaxial wheels round which pressure rollers turn freely.

Centre distance between the geometrical axis of the pair of coaxial wheels and the geometrical axes of said rollers is practically equal to the sum of the radius of
30 each roller and in the wheel of the pair of coaxial wheels on which said roller acts while the distance between the

circumference of each roller and the longitudinal axis of the belt is considerably less than the radius of the wheel on which said roller presses.

Consequently contact is maintained between the belt and
5 each of the two coaxial wheels along an arc of a length sufficient to ensure meshing of several teeth.

The pair of coaxial wheels is served by a device for detecting the extent of slippage between two said wheels. Slippage having been ascertained, an automatic circuit
10 stops the electric motor, reverses its direction of rotation and thus opens the doors.

This device can be made by mounting a switch on one wheel of the pair, said switch responding to the projections present on an undulated cylindrical surface, coaxial and
15 integral with the other wheel, so that the number of pulses received by the switch during said slippage measures its amplitude.

In the door operator described, the transmission pulleys, which connect the two doors by means of cables and the
20 like, are preferably inclined so that one can pass at least partially below the other thus reducing overall bulk of the device.

The invention provides obvious advantages.

The door operator is compact and more rationally designed.
25 The reduction ratio, safety slippage between the motor and the doors, and the automatic mechanisms for reversing movement all consist of a few simple and intelligently conceived parts. Bulk is therefore reduced to a minimum providing a compact, functional and entirely safe
30 door operator.

Characteristics and purposes of the invention will be

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made even clearer by the following examples of its execution illustrated by diagrammatic figures.

Fig.1 Door operator with a pair of coaxial wheels and clutch for working a door with two panels, perspective view.

Fig.2 Side view of the door operator.

Fig.3 Diagram of the door operator.

Fig.4 Detail of the door operator's pair of coaxial wheels and clutch with slippage detecting device, seen from the side, partly cut away.

Fig.5 Cross section detail of the slippage detector.

The door operator 10 mounted on the girder 50 comprises a continuous toothed belt 11 supported by toothed wheels at the ends, the wheel 12 idling on a pin 16 and wheel 13 fixed to the shaft 17 of the electric motor 30 mounted on the girder 50 by means of a bracket 20.

The door panel 40 slides on a rail 41 by means of rollers 42 supported by the plate 48 fixed to the door panel.

Also fixed to said plate 48 is another plate 43 carrying the pair of toothed wheels 14 and 15 idling round a pin 18 fixed to said plate 43.

The diameter of wheel 15 is greater than that of wheel 14. Said wheels 14 and 15 are connected by a disk clutch 25 placed between them.

The branch 11A of the belt 11 connects with the toothed wheel 14 along the whole arc 11C and is pressed by the roller 26 idling round the pin 28 fixed to plate 43.

Branch 11B of the belt 11 connects with the toothed wheel 15 along the whole arc 11D and is pressed by the roller 27 idling round the pin 29 fixed to plate 43.

The toothed wheels 14 and 15 and the intermediate clutch

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25 are pressed together by compression spring 21 inserted onto pin 18 and pressing against the nut 22.

As will be clearly seen in Figs. 4 and 5, the two toothed wheels 14 and 15 are fixed respectively to sleeves 56
5 and 57 supported by the pin 18 and ball bearings 23 and 24. Said sleeves 56 and 57 are connected by a "free wheel" device 58 which permits movement between said wheels 14 and 15 only while the doors are closing. The metal disk 19 is integral with the wheel 14. The accessory 37 is
10 fixed to the plate 48 in turn fixed to the door panel 40.

At one end of the girder 50 that carries the door operator 10 a bracket 49 is mounted to carry the pin 51 for the idling pulley 52 while at the other end of said girder 50 another bracket holds the pin 54 for the idling
15 pulley 53.

Said pulleys 52 and 53 support the continuous cable 60 connecting the door panels 40 and 40', said cable being substantially in alignment with the continuous belt 11. The upper section of the cable 60 is held by means of a
20 bracket 61 to the plate 43 fixed to the door panel 40. A bracket 62 holds the lower section of said cable 60 to the plate 64 which is fixed to the accessory part 65 for operating the other door panel 40'.

Operation

25 On starting up the electric motor the lower section of the belt 11 slides along causing the larger wheel 15 to rotate, while the upper section of said belt causes the smaller wheel 14 to rotate in the same direction and at the same speed as that of wheel 15.
30 Due to the difference in diameters of said wheels 14 and 15 the pin 18 in said wheels is pushed to translate

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transversally pulling the door panel 40 in the direction taken by the belt which turns the smaller wheel 14.

The effect of said pair of wheels 14 and 15 is therefore that of a reducer and the reduction ratio is a function
5 of the difference between the diameters of wheels 14 and 15. In particular, translation of the door panel is equal to the difference between the lengths of the circumferences of wheels 14 and 15 divided by two.

If for any reason the door encounters an obstacle to its
10 closing movement, consequently slowing down and stopping transversal translation of the pin 18 common to both wheels 14 and 15, these latter will continue to rotate in the same direction but at different speeds overcoming the resistance of the clutch 25.

15 Slippage is ascertained by special means connected to an automatic device that stops the electric motor and puts it into reverse. Said means of detection comprise a micro-switch 31 with contact spring 32, fixed to wheel 15, responding to projections 33 present on an undulated cylindrical surface 34 fixed to and coaxial with the wheel 14.
20 Electrical connections comprise double-brush collectors 35 mounted on the support 36 coaxial with pin 18, made of insulating material.

The pulses, generated by the number of microswitch pulsations corresponding to the reciprocal difference of phase
25 between the two wheels 14 and 15, are passed to the automatic device which drives the electric motor by means of a pulse counter which operates a relay only after two or three pulses so that false alarms may be avoided.

30 Fig. 2 shows a door operator similar to that seen in Fig. 1 for sliding more than one door panel, supported and guided

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by rails 41, 70 and 71.

As clearly shown, the pulleys 72 and 73, required for connection between door panels and with their pulling accessories 74 and 75, are placed in an inclined position so that one pulley can to some extent pass beneath the other.

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CLAIMS

1. Linear door operator (10) for the panels (40, 40') of elevator doors characterized in that the panels (40 40') of the door are drawn along by means of a continuous belt (11) supported by two wheels (12 13) at the ends and by means of a pair of coaxial wheels (14 15) of different diameters, joined together, turning idly round a pin (18) fixed to a supporting arm (43) integral with the door panel (40), the operative circumference of the larger wheel (15) maintaining contact with the inner side of one section (11B) of the belt (11) between the two end wheels (12 13) and the operative circumference of the smaller wheel (14) maintaining contact with the inner side of the second section (11A) of the belt (11) moving in an opposite direction to the first section (11B), one wheel (13) of the two end wheels that support said belt (11) being connected to the shaft (17) of an electric motor (30), movement of the panel (40), caused by rotation of the motor (30), at a ratio of reduction compared with the speed of said motor (30), being equal to the algebraic sum of the pull exerted by the two sections (11A 11B) of the belt (11) on the operative circumference of the larger wheel (15) and on that of the smaller wheel (14) respectively.

2. Linear door operator for the panels of elevator doors as in Claim 1, characterized in that the two coaxial wheels (14 15) are held together by means of an intermediate coaxial clutch (25) so that if an obstacle is encountered to closing the door panel (40), with consequent slowing or stopping of the pin (18) common to both wheels (14 15), said wheels, respectively turned by the two sections (11A 11B) of the

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belt (11), will continue to turn in the same direction but at different speeds thus provoking slippage, said slippage being detected by a device that will stop and then reverse motion of the electric motor (30) causing the door to open, it being also possible for the occupant to open the door by hand, in the event of an emergency occurring such as a power failure or some other, causing slippage of the two wheels (14 15) of the above pair, overcoming resistance by the interposed clutch disk (25).

10 3. Door operator as in claim 2, characterized in that the two coaxial wheels (14 15) are served by a mechanical device (58) of the kind termed free wheel or equivalent type, that permits slippage of said wheels (14 15) in the direction of closure of the door panels but not in the opposite direction.

4. Door operator as in claim 2, characterized in that the two coaxial wheels (14 15) are served by a device for detecting the amplitude of slippage between two said wheels (14 15), there being further an automatic circuit which, amplitude of slippage having been ascertained, stops the electric motor (30) and reverses its direction of rotation.

20 5. Door operator as in claim 2, characterized in that the two coaxial wheels (14 15) are served by a device for detecting the amplitude of slippage between said two wheels (14 15), there being further provided an automatic circuit which, on amplitude of slippage having been ascertained, stops the electric motor (30) and reverses its direction of rotation, the device for detecting amplitude of slippage between the pair of coaxial wheels (14 15) being obtained by mounting on one wheel (15)

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of said pair of wheels, a switch (31) actuated by the projections (33) present on the undulated cylindrical surface (34) coaxial and integral with the other wheel (14), so that the number of pulsations transmitted to the switch (31) during slippage measures the amplitude of said slippage.

6. Door operator as in claim 1, characterized in that the wheels (14 15) acting on the belt (11) are toothed as is also said belt (11).

10 7. Door operator as in claim 1, characterized in that the pins (28 29) fixed to the arm (43) supporting the coaxial wheels (14 15) fixed to the panel (40) of the door, and parallel to the geometrical axis of said coaxial wheels (14 15) carry mounted on them two
15 idling rollers (26 27) respectively in contact with one and the other section (11A 11B) of the belt (11) centre distance between the geometrical axis of the pair of coaxial wheels (14 15) and the geometrical axes of said rollers (28 29) being practically equal to the sum of the radii of
20 said rollers (28 29) and of the wheel of the pair of coaxial wheels (14 15) on which said roller presses, the distance between the circumference of each roller (28 29) and the longitudinal axis of the belt (11) being considerably less than the radius of the wheel pressed by said roller,
25 this in order to secure contact between the belt (11) and each of the coaxial wheels (14 15) over an arc (11C 11D) sufficiently long to ensure that said contact is maintained.

8. Door operator as in claim 1, characterized in that transmission pulleys (72 73) for the
30 lift door panels are inclined to allow one to pass partially under the other so reducing total bulk of the door operator (10).

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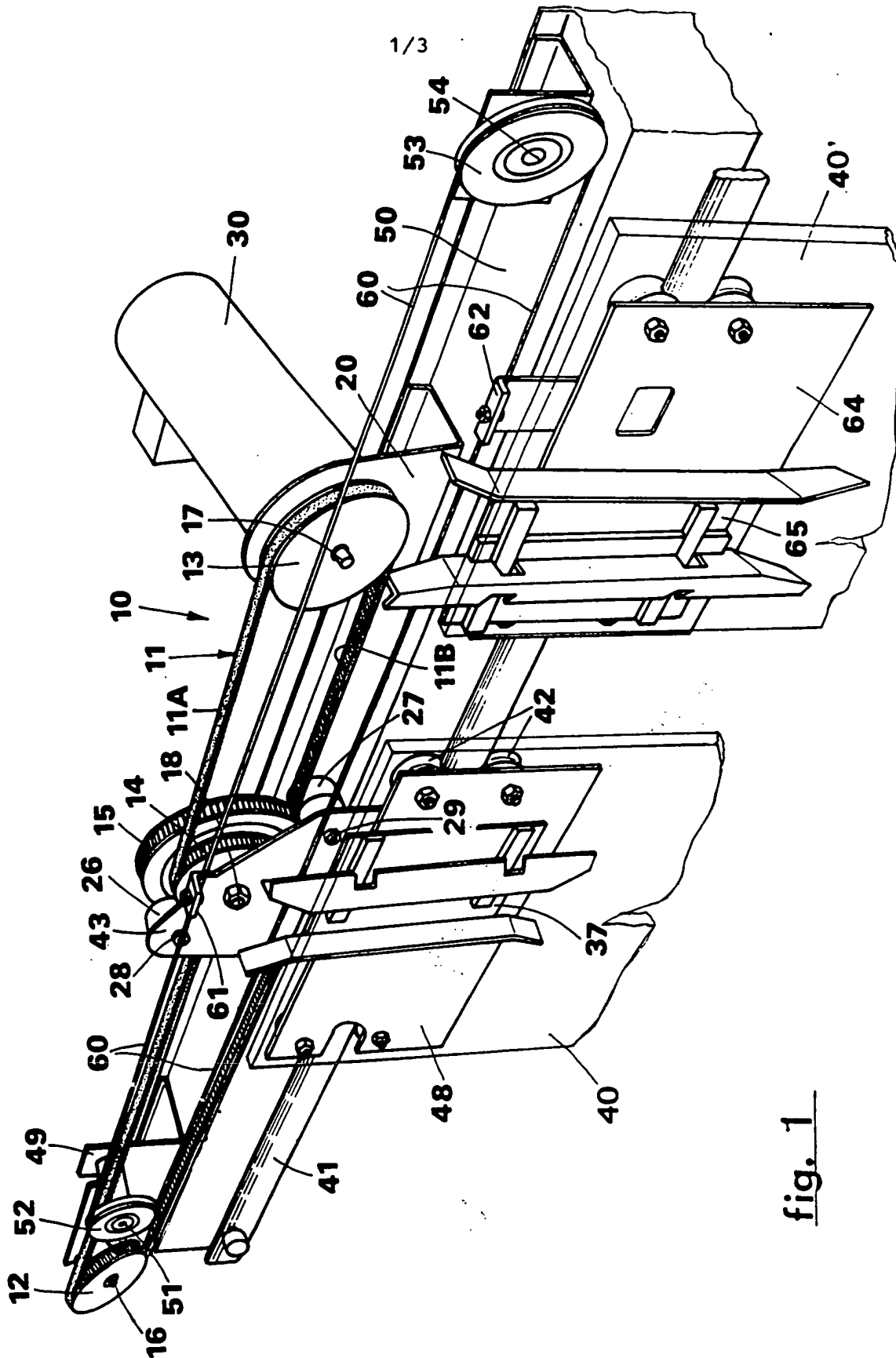


fig. 1

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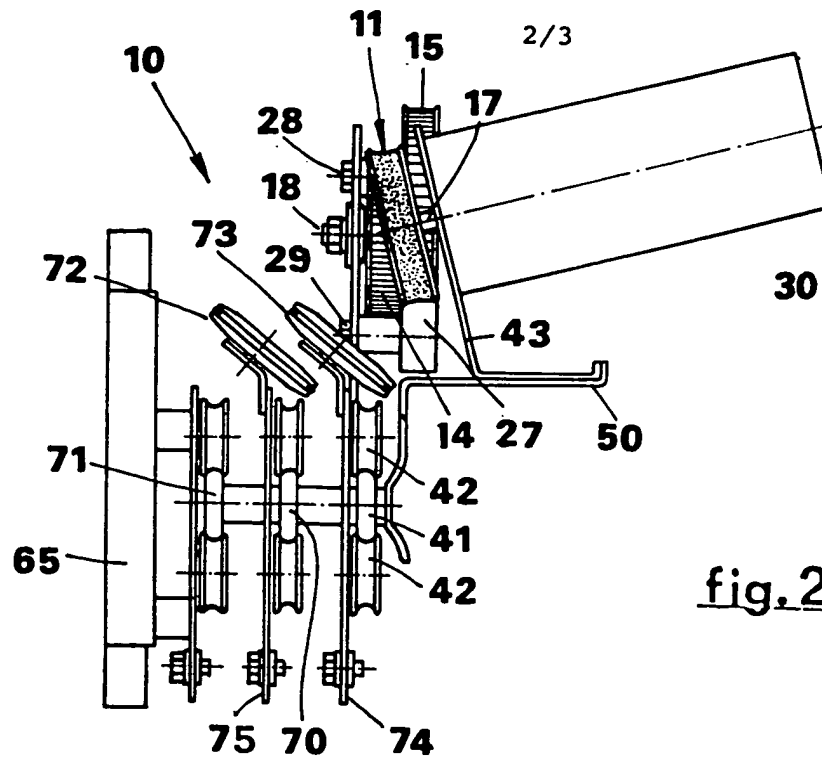


fig. 2

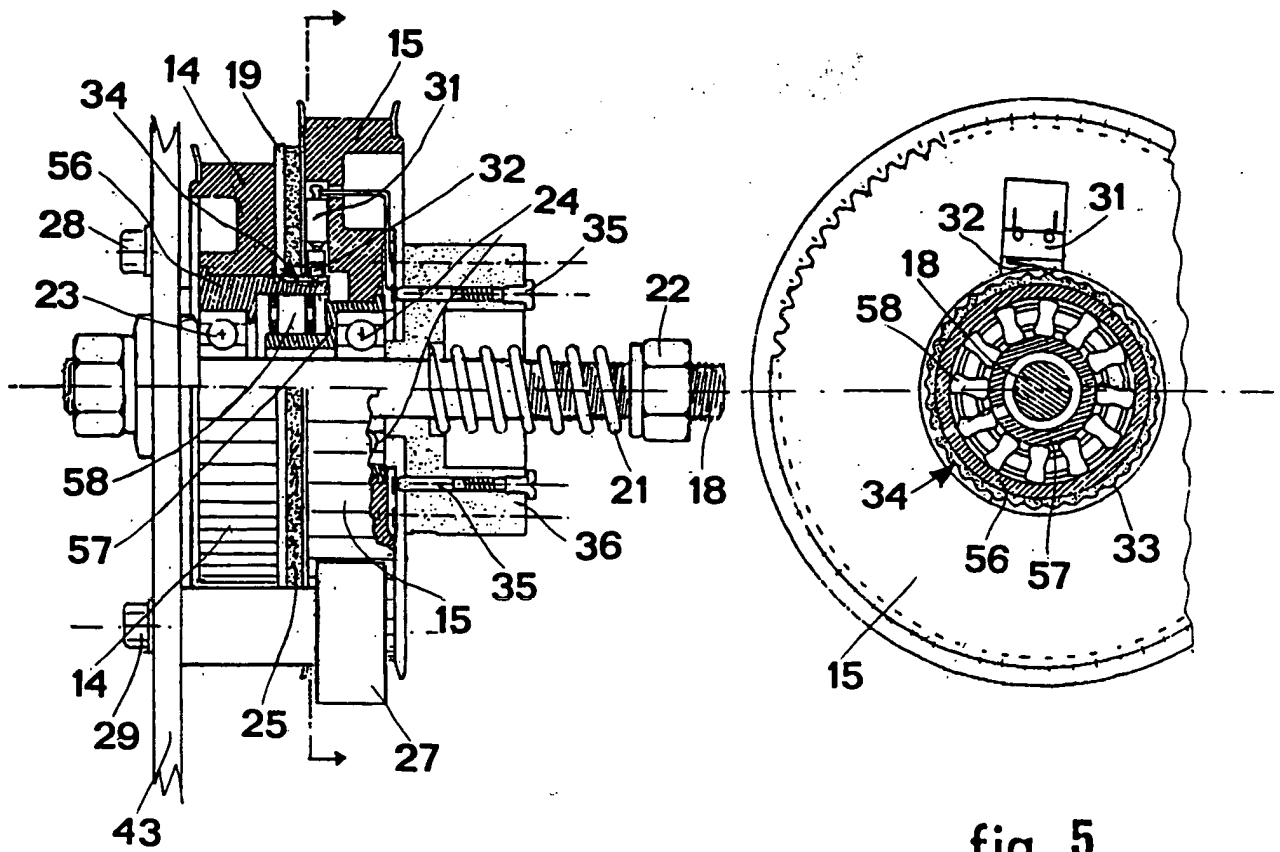


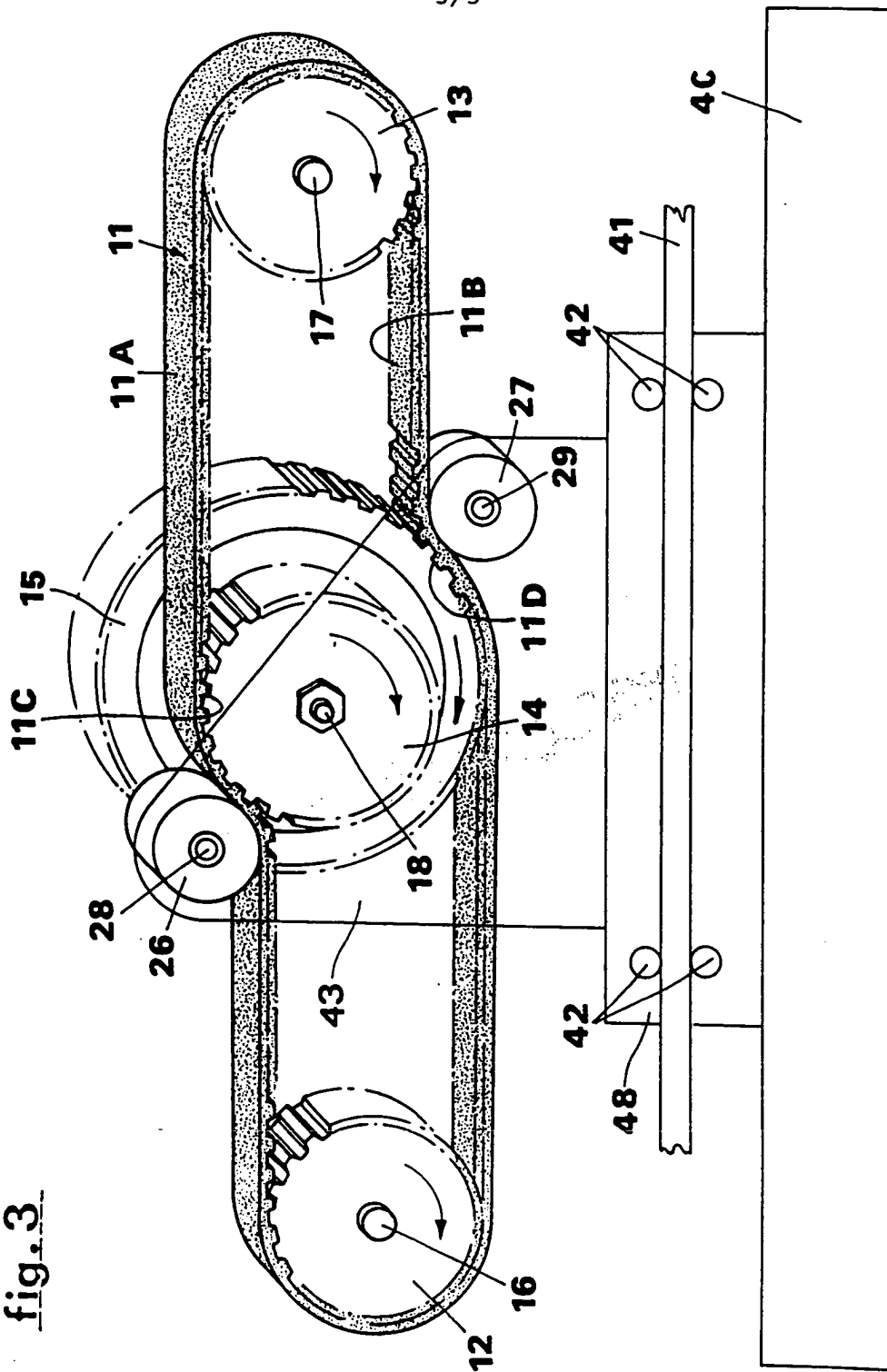
fig. 4

fig. 5

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fig. 3



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INTERNATIONAL SEARCH REPORT

PCT/IT 92/00063

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B66B13/26; B66B13/08; E05F15/10; E05F15/14
F16H19/06**II. FIELDS SEARCHED**Minimum Documentation Searched⁷

Classification System	Classification Symbols
Int.Cl. 5	B66B ; E05F ; F16H

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸**III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹**

Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	EUREKA INCORP: ENGINEERING MATERIALS & DESIGN vol. 10, no. 6, June 1990, KENT, GB page 15 , XP000209904 'DIFFERENTIAL GEARS DRIVE LOW COST MOTIONS' see the whole document ---	1,6
A	GB,A,2 213 524 (EDOS LIMITED) 16 August 1989 see page 5, line 29 - page 7, line 15; figures 3-6 ---	1,2
A	US,A,2 572 196 (RAQUE) 1 October 1947 see column 4, line 5 - line 42 see column 4, line 74 - column 7, line 10; figures 1-3 -----	1,2

⁹ Special categories of cited documents : ¹⁰

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¹¹ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention¹² document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step¹³ document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.¹⁴ document member of the same patent family**IV. CERTIFICATION**

Date of the Actual Completion of the International Search 22 JANUARY 1993	Date of Mailing of this International Search Report 29. 01. 93
International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer CLEARY F.M.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

IT 9200063
SA 62062

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2213524	16-08-89	None	
US-A-2572196		None	